"Naples" PC Lamp/Reel/Switch Interface Hardware Manual

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Revision History

Version	Date	Author	Description
1.0 - Draft	14-Sep-06	A. Graham	Initial draft.
1.1 - Draft	02-Oct-06	A. Graham	Added annotated board layout picture.
1.2 - Draft	27-Feb-07	D Bush	Updated for new board layout

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Introduction

Purpose of Document

This document describes the hardware interface to the AES "Naples" PC Lamp/ Reel/ Switch Controller (PLRSC) as required by a game manufacturer who wishes to connect this to his game peripherals.

Intended Audience

The intended audience of this document is the hardware engineers who will be producing wiring harnesses to connect the PC to the reels, lamps, switches and vacuum fluorescent display.

Document Layout

The document describes the connectors on the Naples board, with pin-outs.

For the multiplexed lamps and switches, a short description of how the lamps and switches are intended to be driven/ connected is included.

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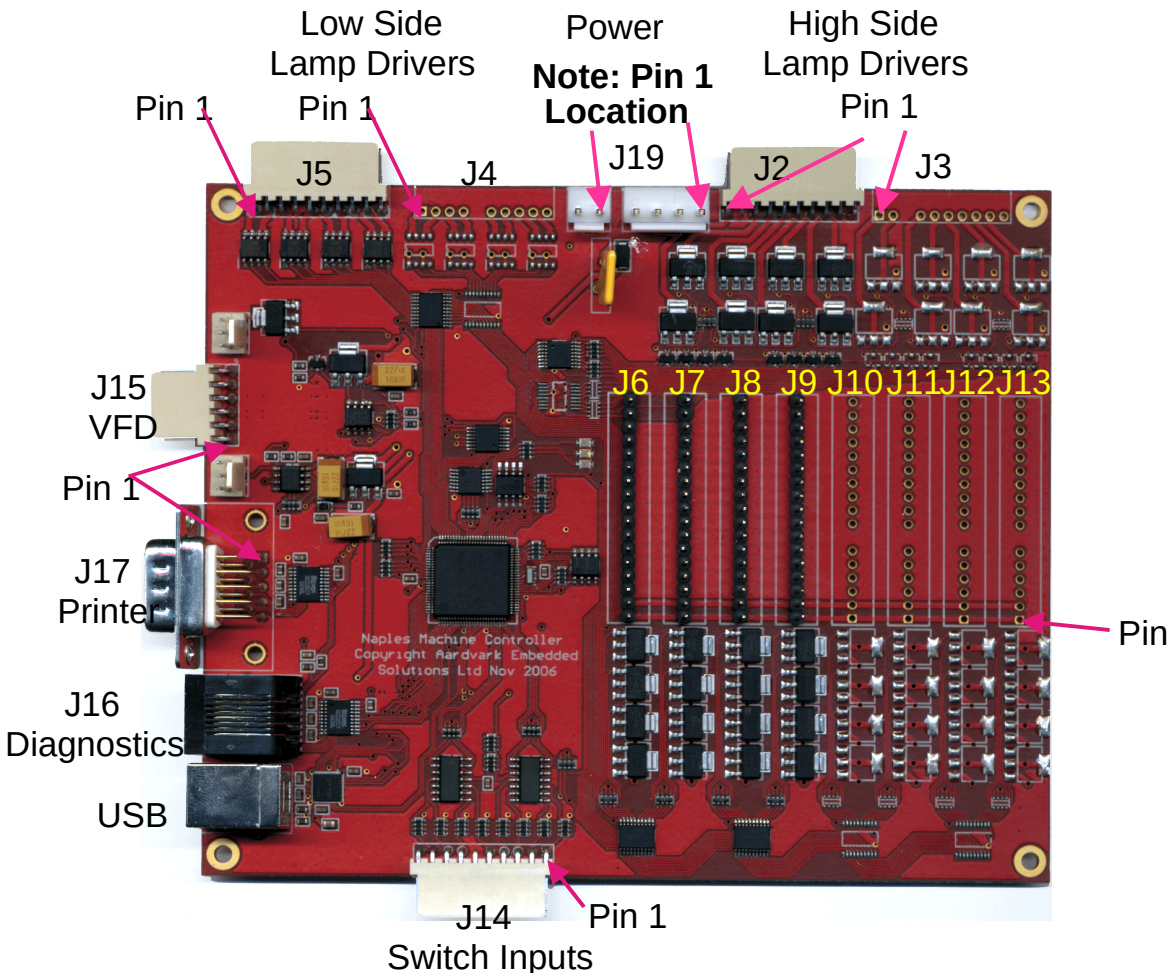
Board Layout

The following diagram shows the various connections to the Naples board.

The polarity of the six-way (2 + 4) power connector should be particularly noted, as pin 1 is at the opposite end of that connector to the pin 1 of each of the other connectors on that board edge. Connecting the power to the board using the incorrect polarity will result in catastrophic damage to the Naples board.



Peripheral Connections

Power Connection

A 2-way JST connector is provided for logic power to be supplied to the board, and a 4 way JST provides the power for the lamps and reels. In order to avoid problems due to noise on the earth lines the 0v supply for these three connectors should **only** be connected at the power supply itself. It is important that the 12V supply to the board must be clean and regulated.

The pinout is as follows:

Connector J19 (Power)	
Pin Number	Signal
1	12 Volt Logic Supply
2	Ground
1	48 Volt Lamp Supply
2	0v Lamp return
3	12 / 24 Volt Motor Supply
4	0v Motor return

Note that all three supplies are complete separate, and must all be fed directly from the power supply itself.

Vacuum Fluorescent Display Connection

The Naples board provides a facility to connect a standard (Starburst) vacuum fluorescent display.

This is achieved via connector J15, which is a 6-way Molex KK connector.

The pinout of connector J15 is as follows:

Connector J15 (VFD)	
Pin Number	Signal
1	12 Volts
2	/SCLOCK
3	No Connect
4	/SDATA
5	RESET
6	Ground

USB Connection

The board is connected to a PC using a standard Type A – Type B USB cable.

The connector on the Naples board is a Type B connector. The USB interface uses USB V 1.1.

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Lamp Connection

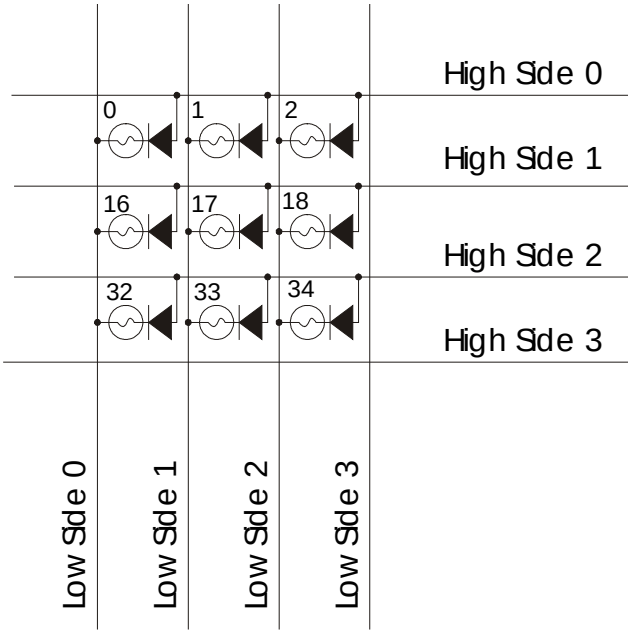
The lamps are driven in a multiplexed fashion, with 16 high-side drivers and 16 low-side drivers.

This provides for a maximum of 256 lamps, though on lower-cost variants of the board not all of the driver transistors will be fitted.

The remainder of this section assumes that all driver transistors **are** fitted.

In order to drive each multiplexed bulb, it needs to be connected to the intersection between a high-side driver transistor and a low-side driver transistor with a series diode.

The following diagram shows a typical connection of a set of filament lamps, with associated diodes, together with how these lamps will be addressed from within the game.



*Bulb Number = (High Side Driver Number * 16) + Low Side Driver Number*

The bulbs are driven by turning on a *single* high-side driver transistor and a *pattern* of low side driver transistors, causing *up to* 16 bulbs to be illuminated simultaneously.

Let us consider these bulbs as standard 12-Volt, 1.2-Watt bulbs. If they were to be driven in a non-multiplexed fashion, then 12 volts would be applied and they (unsurprisingly) would dissipate 1.2 Watts.

Each high side driver transistor is driven for a 1/16th duty cycle, so we obviously have to over-drive the bulbs by a factor of 16 during the “on” period if we are to maintain the same power dissipation.

The power dissipated is equal to the square of the voltage divided by the resistance of the bulb. Since we require *sixteen* times the power, we need to multiply the voltage by *four*.

For 12-Volt bulbs, we therefore need to supply 48 Volts to the Naples board.

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If other bulbs are used, then the voltage supplied could be adjusted to suit. However, the switch read mechanism relies on the 48-volt bulb supply and will not work correctly with other voltage bulbs.

The connectors to the lamp matrix are achieved via four, 10-way Molex KK connectors, as follows:

- Connector J2 – Lamp High Side Drivers 0 .. 7
- Connector J3 – Lamp High Side Drivers 8 .. 15
- Connector J4 – Lamp Low Side Drivers 0 .. 7
- Connector J5 – Lamp Low Side Drivers 8 .. 15

The pin-outs of each of these four connectors are as follows:

Connector J2		Connector J3		Connector J4		Connector J5	
Pin	Signal	Pin	Signal	Pin	Signal	Pin	Signal
1	High 0	1	High 8	1	Low 0	1	Low 8
2	No Fit	2	High 9	2	Low 1	2	Low 9
3	High 1	3	No Fit	3	Low 2	3	Low 10
4	High 2	4	High 10	4	No Fit	4	Low 11
5	High 3	5	High 11	5	Low 3	5	No Fit
6	High 4	6	High 12	6	Low 4	6	Low 12
7	High 5	7	High 13	7	Low 5	7	Low 13
8	High 6	8	High 14	8	Low 6	8	Low 14
9	High 7	9	High 15	9	Low 7	9	Low 15
10	N/C	10	N/C	10	N/C	10	N/C

Reel Lamps

In many reel assemblies, the reels have bulbs fitted to illuminate the win line, together with the lines above and below the win line. On the Naples board, tracking is provided to each standard reel connector to drive the bulbs within the reel assemblies.

*It should be noted that if the standard reel connectors are used to drive to the reel bulbs, then the reel assemblies that have a common anode diode arrangement **must** be used.*

A high side driver is connected to each common anode (0 .. 7) and the top, middle and bottom bulbs of each reel are connected to consecutive low side drivers 0, 1 and 2. This means that the bulbs within the reel assemblies occupy the following positions (bulb numbers) within the bulb matrix:

	Reel 0	**Reel 1**	**Reel 2**	**Reel 3**	**Reel 4**	**Reel 5**	**Reel 6**	**Reel 7**
Top	0	16	32	48	64	80	96	112
Middle	1	17	33	49	65	81	97	113
Bottom	2	18	34	50	66	82	98	114

In a situation where the reel bulbs are being driven via the standard reel connectors, then the corresponding bulb positions should not be populated in the main bulb matrix.

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Reel Connection

A fully-populated Naples board can control 8 reels.

Each reel is connected via a standard, 0.1-inch pitch, 17-pin connector, which is pin-compatible with standard reels.

The pinout of each of these eight connectors is as follows:

Connector J6 (Reel 0)		Connector J7 (Reel 1)		Connector J8 (Reel 2)		Connector J9 (Reel 3)	
Pin	Signal	Pin	Signal	Pin	Signal	Pin	Signal
1	Motor +V	1	Motor +V	1	Motor +V	1	Motor +V
2	Motor +V	2	Motor +V	2	Motor +V	2	Motor +V
3	Red Phase	3	Red Phase	3	Red Phase	3	Red Phase
4	Yellow Phase	4	Yellow Phase	4	Yellow Phase	4	Yellow Phase
5	Violet Phase	5	Violet Phase	5	Violet Phase	5	Violet Phase
6	Black Phase	6	Black Phase	6	Black Phase	6	Black Phase
7	No Fit	7	No Fit	7	No Fit	7	No Fit
8	No Connect	8	No Connect	8	No Connect	8	No Connect
9	+5 V Opto	9	+5 V Opto	9	+5 V Opto	9	+5 V Opto
10	Home Sense	10	Home Sense	10	Home Sense	10	Home Sense
11	0 V Opto	11	0 V Opto	11	0 V Opto	11	0 V Opto
12	Top Bulb (-)	12	Top Bulb (-)	12	Top Bulb (-)	12	Top Bulb (-)
13	Middle Bulb (-)	13	Middle Bulb (-)	13	Middle Bulb (-)	13	Middle Bulb (-)
14	Bottom Bulb (-)	14	Bottom Bulb (-)	14	Bottom Bulb (-)	14	Bottom Bulb (-)
15	Bulb Common (+)	15	Bulb Common (+)	15	Bulb Common (+)	15	Bulb Common (+)
16	No Connect	16	No Connect	16	No Connect	16	No Connect
17	No Connect	17	No Connect	17	No Connect	17	No Connect

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Connector J10 (Reel 4)		Connector J11 (Reel 5)		Connector J12 (Reel 6)		Connector J13 (Reel 7)	
Pin	Signal	Pin	Signal	Pin	Signal	Pin	Signal
1	Motor +V	1	Motor +V	1	Motor +V	1	Motor +V
2	Motor +V	2	Motor +V	2	Motor +V	2	Motor +V
3	Red Phase	3	Red Phase	3	Red Phase	3	Red Phase
4	Yellow Phase	4	Yellow Phase	4	Yellow Phase	4	Yellow Phase
5	Violet Phase	5	Violet Phase	5	Violet Phase	5	Violet Phase
6	Black Phase	6	Black Phase	6	Black Phase	6	Black Phase
7	No Fit	7	No Fit	7	No Fit	7	No Fit
8	No Connect	8	No Connect	8	No Connect	8	No Connect
9	+5 V Opto	9	+5 V Opto	9	+5 V Opto	9	+5 V Opto
10	Home Sense	10	Home Sense	10	Home Sense	10	Home Sense
11	0 V Opto	11	0 V Opto	11	0 V Opto	11	0 V Opto
12	Top Bulb (-)	12	Top Bulb (-)	12	Top Bulb (-)	12	Top Bulb (-)
13	Middle Bulb (-)	13	Middle Bulb (-)	13	Middle Bulb (-)	13	Middle Bulb (-)
14	Bottom Bulb (-)	14	Bottom Bulb (-)	14	Bottom Bulb (-)	14	Bottom Bulb (-)
15	Bulb Common (+)	15	Bulb Common (+)	15	Bulb Common (+)	15	Bulb Common (+)
16	No Connect	16	No Connect	16	No Connect	16	No Connect
17	No Connect	17	No Connect	17	No Connect	17	No Connect

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Switch Connection

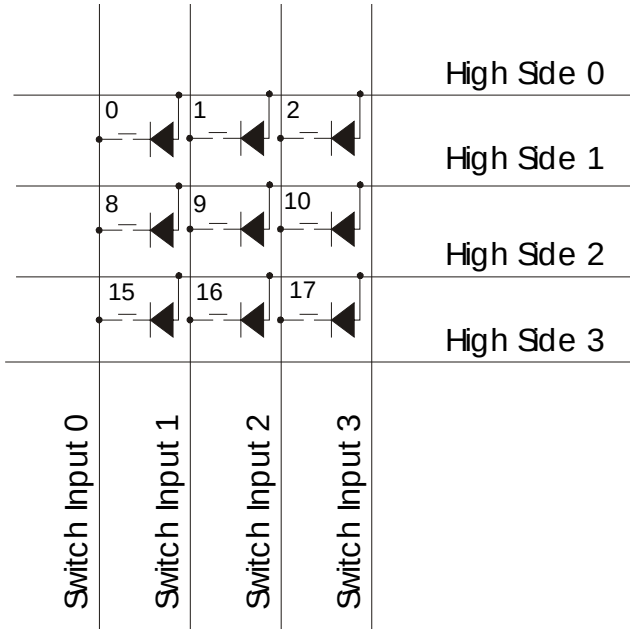
The switches are read in a multiplexed fashion, using the same 16 high-side drivers (and connectors) that are used for lamps and reading eight switches at a time though a dedicated connector.

This provides for a maximum of 128 switches, though on lower-cost variants of the board not all of the high-side driver transistors will be fitted.

The remainder of this section assumes that all driver transistors **are** fitted.

In order to read each multiplexed switch, it needs to be connected to the intersection between a high-side driver transistor and a low-side driver transistor with a series diode.

The following diagram shows a typical connection of a set of switches, with associated diodes, together with how these switches will be addressed from within the game.



*Switch Number = (High Side Driver Number * 8) + Switch Input Number*

The connectors to the switch matrix are achieved via three, 10-way Molex KK connectors, as follows:

- Connector J2 – Lamp High Side Drivers 0 .. 7
- Connector J3 – Lamp High Side Drivers 8 .. 15
- Connector J4 – Lamp Low Side Drivers 0 .. 7
- Connector J5 – Lamp Low Side Drivers 8 .. 15

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The pin-outs of each of these three connectors are as follows:

Connector J2		Connector J3		Connector J14 Switch Inputs	
Pin Number	Signal	Pin Number	Signal	Pin Number	Signal
1	High 0	1	High 8	1	Switch Input 0
2	No Fit	2	High 9	2	Switch Input 1
3	High 1	3	No Fit	3	Switch Input 2
4	High 2	4	High 10	4	Switch Input 3
5	High 3	5	High 11	5	Switch Input 4
6	High 4	6	High 12	6	No Fit
7	High 5	7	High 13	7	Switch Input 5
8	High 6	8	High 14	8	Switch Input 6
9	High 7	9	High 15	9	Switch Input 7
10	No Connect	10	No Connect	10	No Connect

Diagnostic Connection

The diagnostics and reprogramming port (J 16) is primarily intended for internal AES use.

Users must **not** connect **anything** to this port without **prior instruction from AES**.

The pinout is included here for completeness.

Connector J16 (Diagnostics)	
Pin Number	Signal
1	No Connect
2	Ground
3	Transmit Data
4	Receive Data
5	Request To Send
6	Clear To Send
7	/Reprogram
8	Ground

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Printer Connection (Not Yet Supported)

A male, 9-way D-Type connector is provided, which is available for future applications.

At time of writing, there is no support for this printer port, either within the API definition or within the embedded firmware.

The pinout is included here for completeness.

Connector J17 (Printer)	
Pin Number	Signal
1	No Connect
2	Receive Data
3	Transmit Data
4	Request To Send
5	Ground
6	No Connect
7	Request To Send
8	Clear To Send
9	No Connect

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